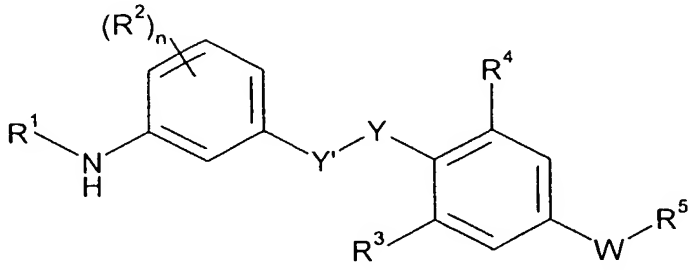
Claims

1. A compound of formula (I) or a pharmaceutically acceptable ester, amide, solvate or salt thereof, including a salt of such an ester or amide, and a solvate of such an ester, amide or salt,



(I)

wherein:

R^1 is selected from hydrogen, C_{1-8} alkyl, C_{2-8} alkenyl, C_{2-8} alkynyl, C_{3-8} cycloalkyl and C_{3-8} cycloalkyl-C_{1-3} alkyl, said alkyl, alkenyl or alkynyl groups or portions of groups optionally being substituted with 1, 2 or 3 groups independently selected from halogen, hydroxy, methoxy, halomethoxy, dihalomethoxy, and trihalomethoxy; said cycloalkyl groups or portions of groups optionally being substituted with 1, 2 or 3 groups independently selected from halogen, hydroxy, C_{1-4} alkyl, C_{2-4} alkenyl, C_{2-4} alkynyl, methoxy, halomethoxy, dihalomethoxy, and trihalomethoxy, haloC_{1-4} alkyl, dihaloC_{1-4} alkyl and trihaloC_{1-4} alkyl;

Each R^2 is independently selected from halogen, mercapto, nitro, cyano, C_{1-4} alkoxy, $-CO_2R^c$, $-CONHR^c$, -CHO, $-SO_2R^6$, $-SO_2NHR^6$, C_{1-4} alkyl, C_{2-4} alkenyl, C_{2-4} alkynyl, NHR^1 and $N(R^1)_2$, said alkyl, alkenyl, alkynyl or alkoxy groups optionally being substituted with 1, 2 or 3 groups selected from halogen, hydroxy, C_{1-4} alkoxy, C_{1-4} alkylthio, mercapto, nitro, cyano, halomethoxy, dihalomethoxy, and trihalomethoxy;

n is 0, 1, 2 or 3;

Y and Y' together are $-C(R^{a'})=C(R^{a'})-$,
or alternatively Y and Y' are independently selected from oxygen, sulphur and $-CH(R^a)-$, with the proviso that at least one of Y and Y' is $-CH(R^a)-$ and the further proviso that when one of Y and Y' is oxygen or sulphur, then R^a is hydrogen, halogen, C_{1-4} alkyl, C_{2-4} alkenyl, C_{2-4} alkynyl, fluoromethyl, difluoromethyl, or trifluoromethyl;

R^a is selected from hydrogen, halogen, hydroxy, mercapto, C_{1-4} alkyl, C_{2-4} alkenyl, C_{2-4} alkynyl, C_{1-4} alkoxy, fluoromethyl, difluoromethyl, trifluoromethyl, fluoromethoxy, difluoromethoxy, trifluoromethoxy, methylthio, fluoromethylthio, difluoromethylthio and thiotrifluoromethyl;

$R^{a'}$ is selected from hydrogen, halogen, mercapto, C_{1-4} alkyl, C_{2-4} alkenyl, C_{2-4} alkynyl, C_{1-4} alkoxy, fluoromethyl, difluoromethyl, trifluoromethyl, fluoromethoxy, difluoromethoxy, trifluoromethoxy, methylthio, fluoromethylthio, difluoromethylthio and thiotrifluoromethyl;

R^3 and R^4 are independently selected from halogen, C_{1-4} alkyl, C_{2-4} alkenyl, C_{2-4} alkynyl, fluoromethyl, difluoromethyl, trifluoromethyl, C_{1-4} alkoxy, fluoromethoxy, difluoromethoxy, trifluoromethoxy, methylthio, fluoromethylthio, difluoromethylthio and trifluoromethylthio;

W is selected from C_{1-3} alkylene, C_{2-3} alkenylene, C_{2-3} alkynylene, $N(R^b)$-C_{1-3} alkylene, C(O)-C_{1-3} alkylene, S-C_{1-3} alkylene, O-C_{1-3} alkylene, C_{1-3} alkylene-O-C_{1-3} alkylene, C(O)NH-C_{1-3} alkylene, NH(CO)-C_{0-3} alkylene, and C_{1-3} alkyleneC(O)NH-C_{1-3} alkylene, said alkylene, alkenylene or alkynylene groups or portions of groups optionally being substituted with 1 or 2 groups selected from hydroxy, mercapto, amino, halo, C_{1-3} alkyl, C_{1-3} alkoxy, phenyl, C_{1-3} alkyl substituted with phenyl, haloC_{1-3} alkyl, dihaloC_{1-3} alkyl, trihaloC_{1-3} alkyl, haloC_{1-3} alkoxy, dihaloC_{1-3} alkoxy, trihaloC_{1-3} alkoxy and phenyl substituted with 1, 2 or 3 halogen atoms;

R^b is selected from hydrogen, hydroxy, C_{1-4} alkyl, C_{2-4} alkenyl, C_{2-4} alkynyl, C_{1-4} alkoxy, fluoromethyl, difluoromethyl, trifluoromethyl, fluoromethoxy, difluoromethoxy, and trifluoromethoxy;

R^5 is selected from $-CO_2R^c$, $-PO(OR^c)_2$, $-PO(OR^c)NH_2$, $-SO_2OR^c$, $-COCO_2R^c$, $CONR^cOR^c$, $-SO_2NHR^c$, $-NHSO_2R^{c'}$, $-CONHSO_2R^c$, and $-SO_2NHCOR^c$;

Each R^c is independently selected from hydrogen, C_{1-4} alkyl, C_{2-4} alkenyl and C_{2-4} alkynyl;

$R^{c'}$ is selected from R^c, C_{5-10} aryl and C_{5-10} aryl substituted with 1, 2 or 3 groups independently selected from amino, hydroxy, halogen and C_{1-4} alkyl;

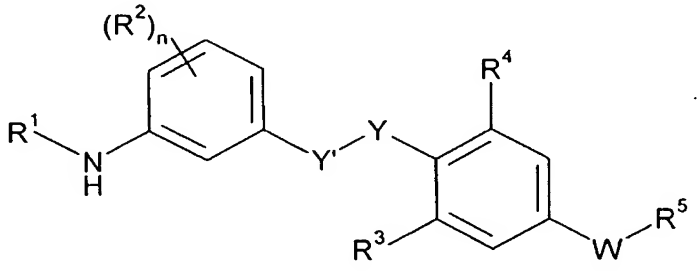
with the proviso that when simultaneously n=0, $R^3 = R^4 = Br$, Y = O, Y'= CH_2, W= CH_2-CH_2 and $R^5 = CO_2H$, then R_1 is not ethyl or hydrogen.

2. A compound as claimed in claim 1 wherein R^1, R^2, n, R^3, R^4 and R^5 are as defined in claim 1;

Y and Y' are independently selected from oxygen, sulphur or -CH(R^a)-, with the proviso that at least one of Y and Y' is -CH(R^a)- and the further proviso that when one of Y and Y' is oxygen or sulphur, then R^a is hydrogen, halogen, C_{1-4} alkyl, C_{2-4} alkenyl, C_{2-4} alkynyl, fluoromethyl, difluoromethyl, trifluoromethyl; and

W is selected from C_{1-3} alkylene, C_{2-3} alkenylene, C_{2-3} alkynylene, N(R^b)-C_{1-3} alkylene, C(O)-C_{1-3} alkylene, S-C_{1-3} alkylene, O-C_{1-3} alkylene, C(O)NH-C_{1-3} alkylene, and NH(CO)-C_{0-3} alkylene, said alkylene, alkenylene or alkynylene groups or portions of groups optionally being substituted with 1 or 2 groups selected from hydroxy, mercapto, amino, halo, C_{1-3} alkyl, C_{1-3} alkoxy, haloC_{1-3} alkyl, dihaloC_{1-3} alkyl, trihaloC_{1-3} alkyl, haloC_{1-3} alkoxy, dihaloC_{1-3} alkoxy, and trihaloC_{1-3} alkoxy.

3. A compound as claimed in claim 1 which is a compound according to formula (Ia) or a pharmaceutically acceptable ester, amide, solvate or salt thereof, including a salt of such an ester or amide, and a solvate of such an ester, amide or salt,



(Ia)

wherein:

n is 0, 1, 2 or 3;

When n = 0 and simultaneously R^3 and R^4 are both Br, R^1 is selected from methyl, n-propyl, i-propyl, cyclobutyl, i-butyl n-butyl and t-butyl, C_{2-4} alkenyl and C_{3-6} cycloalkyl-C_{1-3} alkyl, said methyl, propyl, butyl, alkyl or alkenyl groups or portions of groups optionally being substituted with 1, 2 or 3 groups independently selected from halogen, methoxy, halomethoxy, dihalomethoxy, and trihalomethoxy, said cycloalkyl groups or portions of groups optionally being substituted with 1, 2 or 3 groups independently selected from halogen, methyl, ethyl, methoxy, halomethoxy dihalomethoxy, and trihalomethoxy;

When n = 0 and simultaneously R^3 and R^4 are not both Br, or when n = 1, 2 or 3, R^1 is selected from hydrogen, C_{1-4} alkyl, C_{2-4} alkenyl and C_{3-6} cycloalkyl-C_{1-3} alkyl, said alkyl or alkenyl groups or portions of groups optionally being substituted with 1, 2 or 3 groups independently selected from

halogen, methoxy, halomethoxy, dihalomethoxy, and trihalomethoxy, said cycloalkyl groups or portions of groups optionally being substituted with 1, 2 or 3 groups independently selected from halogen, methyl, ethyl, methoxy, halomethoxy, dihalomethoxy, and trihalomethoxy;

Each R^2 is independently selected from halogen, C_{1-2} alkyl, C_{2-3} alkenyl, C_{2-3} alkynyl, C_{1-2} alkoxy, haloC_{1-2} alkyl, dihaloC_{1-2} alkyl, and trihaloC_{1-2} alkyl.

Y and Y' together are $-C(R^{a'})=C(R^{a'})-$,
or alternatively Y is O or S, and Y' is $-CH(R^a)-$;

R^a is selected from hydrogen, halogen, C_{1-2} alkyl, fluoromethyl, difluoromethyl and trifluoromethyl;

$R^{a'}$ is selected from hydrogen, halogen, C_{1-2} alkyl, fluoromethyl, difluoromethyl and trifluoromethyl;

R^3 and R^4 are independently selected from halogen, C_{1-4} alkyl, fluoromethyl, difluoromethyl and trifluoromethyl;

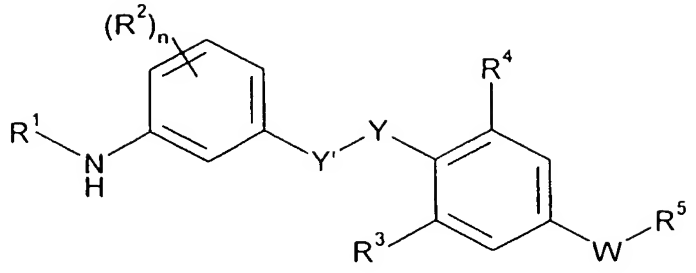
W is selected from C_{1-3} alkylene, C_{2-3} alkenylene, O-C_{1-3} alkylene, C_{1-3} alkylene-O-C_{1-3} alkylene, C(O)-C_{1-2} alkylene, C(O)NH-C_{1-2} alkylene and NH(CO)-C_{1-2} alkylene; the alkylene group or portion of a group optionally being substituted with one or more halo groups.

R^5 is selected from $-CO_2R^c$, $-PO(OR^c)_2$, $-SO_2OR^c$, $-NHSO_2R^{c'}$, $-COCO_2R^c$ and $CONR^cOR^c$;

Each R^c is independently selected from ethyl, methyl and hydrogen; and

$R^{c'}$ is selected from R^c, phenyl and phenyl substituted with 1, 2 or 3 groups independently selected from amino, hydroxyl, halogen or methyl.

4. A compound as claimed in any of claims 1 to 3 which is a compound according to formula (Ib) or a pharmaceutically acceptable ester, amide, solvate or salt thereof, including a salt of such an ester or amide, and a solvate of such an ester, amide or salt,



(Ib)

wherein:

n is 0, 1, 2 or 3;

When n = 0 and simultaneously R^3 and R^4 are both Br, R^1 is selected from methyl, n-propyl, i-propyl, cyclobutyl, i-butyl n-butyl and t-butyl, C_{2-4} alkenyl and C_{3-6} cycloalkyl-C_{1-3} alkyl;

When n = 0 and simultaneously R^3 and R^4 are not both Br, or when n = 1, 2 or 3, R^1 is selected from hydrogen, C_{1-4} alkyl, C_{2-4} alkenyl and C_{3-6} cycloalkyl-C_{1-3} alkyl;

Each R^2 is independently selected from halogen, C_{1-2} alkyl, C_{2-3} alkenyl, C_{2-3} alkynyl, C_{1-2} alkoxy, haloC_{1-2} alkyl, dihaloC_{1-2} alkyl, and trihaloC_{1-2} alkyl.

Y and Y' together are $-C(R^{a'})=C(R^{a'})-$,
or alternatively Y is O and Y' is $-CH(R^a)-$;

R^a is selected from hydrogen, halogen, and C_{1-2} alkyl;

$R^{a'}$ is selected from hydrogen, halogen, and C_{1-2} alkyl;

R^3 and R^4 are independently selected from halogen, C_{1-4} alkyl, fluoromethyl, difluoromethyl and trifluoromethyl;

W is selected from C_{1-3} alkylene, C_{2-3} alkenylene, O-C_{1-3} alkylene, C_{1-3} alkylene-O-C_{1-3} alkylene, C(O)NH-C_{1-2} alkylene and NH(CO)-C_{1-2} alkylene; the alkylene group or portion of a group optionally being substituted with one or more halo groups.

R^5 is $-CO_2R^c$;

Each R^c is independently selected from ethyl, methyl and hydrogen.

5. A compound as claimed in any of claims 1 to 4 for use as a medicament.

6. A compound as defined in any of claims 1 to 4 or a pharmaceutically acceptable ester, amide, solvate or salt thereof, including a salt of such an ester or amide, and a solvate of such an ester, amide or salt, for use in the treatment or prophylaxis of a condition associated with a disease or disorder associated with thyroid receptor activity,

7. A method for the treatment or prophylaxis of a disease or disorder associated with thyroid receptor activity in a mammal, which comprises administering to the mammal a therapeutically effective amount of a compound of formula (I) as defined in claim 1 or claim 2 or a pharmaceutically acceptable ester, amide, solvate or salt thereof, including a salt of such an ester or amide, and a solvate of such an ester, amide or salt.

8. Use of a compound as defined in any of claims 1 to 4 or a pharmaceutically acceptable ester, amide, solvate or salt thereof, including a salt of such an ester or amide, and a solvate of such an ester, amide or salt, for the manufacture of a medicament for the treatment or prophylaxis of a disease or disorder associated with thyroid receptor activity.

9. A pharmaceutical formulation comprising a compound as defined in any of claims 1 to 4 or a pharmaceutically acceptable ester, amide, solvate or salt thereof, including a salt of such an ester or amide, and a solvate of such an ester, amide or salt, and a pharmaceutically acceptable excipient.

10. A pharmaceutical composition as claimed in claim 9 further comprising an additional therapeutic agent selected from cholesterol/lipid lowering agents, hypolipidemic agents, anti-atherosclerotic agents, anti-diabetic agents, anti-osteoporosis agents, anti-obesity agents, growth promoting agents, anti-inflammatory agents, anti-anxiety agents, anti-depressants, anti-hypertensive agents, cardiac glycosides, appetite supressants, bone resorption inhibitors, thyroid mimetics, anabolic agents, anti-tumor agents and retinoids.

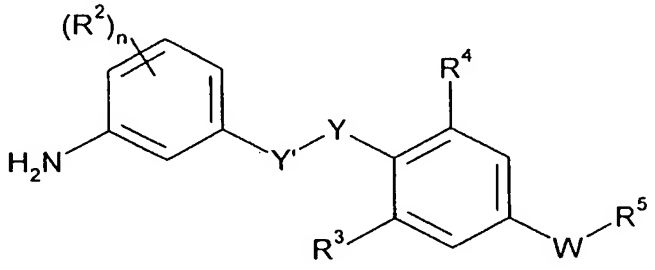
11. Use of a compound as defined in claim 6 in labelled form as a diagnostic agent for the diagnosis of conditions condition associated with a disease or disorder associated with thyroid receptor activity.

12. A method of discovering a ligand of the thyroid hormone receptor which comprising use of a compound as defined in any of claims 1 to 4 or a compound as defined in any of claims 1 to 4 in labelled form, as a reference compound. .

13. A compound as claimed in claim 6, a method as claimed in claim 7, a use as claimed in claim 8 or claim 11, or a pharmaceutical formulation as claimed in claim 9 or claim 10 wherein the condition associated with a disease or disorder associated with thyroid receptor activity is selected from (1) hypercholesterolemia, dyslipidemia or any other lipid disorder manifested by an unbalance of blood or tissue lipid levels ; (2) atherosclerosis; (3) replacement therapy in elderly subjects with hypothyroidism who are at risk for cardiovascular complications; (4) replacement therapy in elderly subjects with subclinical hypothyroidism who are at risk for cardiovascular complications; (5) obesity; (6) diabetes (7) depression; (8) osteoporosis (especially in combination with a bone resorption inhibitor); (9) goiter; (10) thyroid cancer; (11) cardiovascular disease or congestive heart failure; (12) glaucoma; and (13) skin disorders.

14. A method for preparing a compound of formula (I) as defined in claim 1 in which R^1 is not H, comprising a step of reacting

- a compound of formula (II)



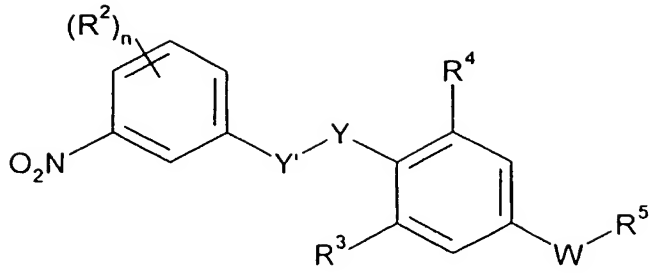
(II)

wherein R^2, n, Y', Y, R^3, R^4, W and R^5 are as defined in claim 1

- with a compound of formula $R^{1'}$-CHO or $R^{1''}$-C(O)-$R^{1'''}$, wherein $R^{1'}$, $R^{1''}$ and $R^{1'''}$ are chosen such that the product compound comprises the group R^1 as defined in claim 1, optionally in the presence of a reducing agent, followed optionally by interconversion to another compound as defined in claim 1.

15. A method for preparing a compound of formula (I) as described in claim 1 in which R^1 is hydrogen, comprising a step of reacting

- a compound of formula (III)



(III)

wherein R^2, n, Y', Y, R^3, R^4, W and R^5 are as defined in claim 1

- with a suitable reducing agent, followed optionally by interconversion to another compound as defined in claim 1.

16. A pharmaceutical composition as claimed in claim 10 wherein the additional therapeutic agent is a hypolipidemic agent selected from the group consisting of an acyl coenzyme A cholesterol acyltransferase (ACAT) inhibitor, a microsomal triglyceride transfer protein (MTP) inhibitor, a cholesterol ester transfer protein (CETP) inhibitor, a ileal bile acid transporter (IBAT) inhibitor, any cholesterol absorption inhibitor, a 3-hydroxy-3-methylglutaryl coenzyme A (HMG-CoA) reductase inhibitor, a squalene synthetase inhibitor, a bile acid sequestrant, a peroxisome proliferator-activator receptor (PPAR)-alpha agonist, a peroxisome proliferator-activator receptor (PPAR)-delta agonist, any peroxisome proliferator-activator receptor (PPAR)-gamma/delta dual agonist, any peroxisome proliferator-activator receptor (PPAR)-alpha/delta dual agonist, a nicotinic acid or a derivative thereof, and a thiazolidinedione or a derivative thereof.

17. A pharmaceutical composition as claimed in claim 10 wherein the additional therapeutic agent is a hypolipidemic agent selected from the group consisting of ezetimibe, simvastatin, atorvastatin, rosuvastatin, cerivastatin, fluvastatin, lovastatin, pravastatin, fenofibrate, gemfibrozil and bezafibrate.

18. A pharmaceutical composition as claimed in claim 10 wherein the additional therapeutic agent is an antidiabetic agent selected from the group consisting of a biguanide, a glucosidase inhibitor, a meglitinide, a sulfonylurea, a thiazolidinedione, a peroxisome proliferator-activator receptor (PPAR)-alpha agonist, a peroxisome proliferator-activator receptor (PPAR)-gamma agonist, a peroxisome proliferator-activator receptor (PPAR) alpha/gamma dual agonist, a sodium glucose co-transporter (SGLT) 1, 2 or 3 inhibitor, a glycogen phosphorylase inhibitor, an aP2 inhibitor, a glucagon-like peptide-1 (GLP-1), a dipeptidyl peptidase IV inhibitor, a glucocorticoid (GR) antagonist and insulin.

19. A pharmaceutical composition as claimed in claim 10 wherein the additional therapeutic agent is an antidiabetic agent selected from the group consisting of metformin, glyburide, glimepiride, glipyride, glipizide, chlorpropamide, gliclazide, acarbose, miglitol, troglitazone, pioglitazone, englitazone, darglitazone, rosiglitazone and insulin.

20. A pharmaceutical composition as claimed in claim 10 wherein the additional therapeutic agent is an anti-obesity agent is selected from the group consisting of an aP2 inhibitor, a peroxisome proliferator-activator receptor (PPAR) gamma antagonist, a peroxisome proliferator-activator receptor (PPAR) delta agonist, a beta-3 adrenergic agonist, a lipase inhibitor, a serotonin reuptake inhibitor and an anorectic agent.